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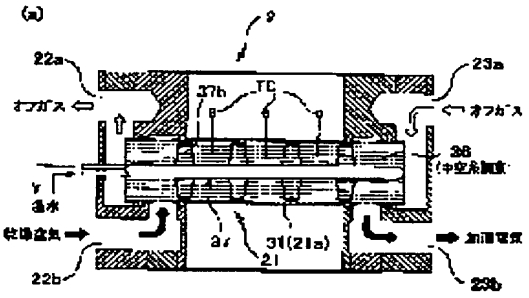
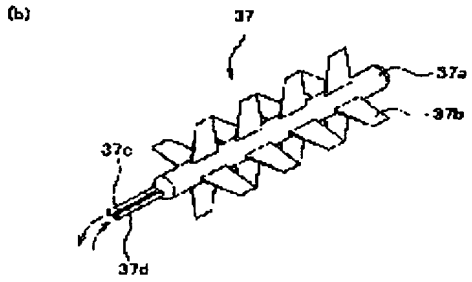
(54) HUMIDIFIER FOR FUEL CELL

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a humidifier for a fuel cell equipped with a heating means by which the possessed heat of the cooling water of the fuel cell can be used effectively for heating of a hollow yarn membrane so that the moisture in the hollow fiber film may not freeze in a cold district and the like.
SOLUTION: The humidifier 2 for fuel cells is constituted by accommodating a large number of water permeating hollow yarn membranes allotted along the length direction of a housing 31 in the above housing 31, and by performing moisture exchange between the above gases by making the gases, of which the moisture contents differ on the inside and outside of the hollow yarn films, respectively, pass through, to humidify the dry gas of lower moisture content. It has a heating means, which can supply quantity of heat to the hollow yarn membrane bunch 36 which has been bundled the hollow yarn membranes, and the cooling water (warm water) after cooling the fuel cell body is used as a source of heating the heating means.





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CLAIMS

[Claim(s)]
[Claim 1] The hollow fiber of water permeability of a large number allotted along with the longitudinal direction of housing is contained in said housing. In the humidification equipment for fuel cells which carries out conduction of the gas from which a moisture content differs on the inside and the outside of said hollow fiber, respectively, performs moisture exchange between said gases, and humidifies few desiccation gases of a moisture content Humidification equipment for fuel cells characterized by using cooling water after equipping the hollow fiber bundle which bundled said hollow fiber with the heating means which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heating means.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the humidification equipment using the hollow fiber of water permeability which can also use a cold district suitably for fuel cells in more detail about the humidification equipment for fuel cells.
[0002]
[Description of the Prior Art] Although there is a thing of a solid-state macromolecule mold in a fuel cell, in the fuel cell which attracts attention as a source of power of an electric vehicle etc., the humidification equipment which carries out moisture exchange of the moisture of the off-gas which is humid gas discharged from the fuel cell at desiccation air is used in recent years. As humidification equipment used for such a fuel cell, what has few power consumption is suitable. moreover, an installation tooth space is small -- so to speak, compactability is searched for. Therefore, although there are classes, such as ultrasonic humidification, steam humidification, evaporation type humidification, and nozzle injection, as humidification equipment, the thing using the hollow fiber as humidification equipment used for a fuel cell is used suitably.
[0003] There are some which were indicated by JP,7-71795,A as humidification equipment using the conventional hollow fiber. If this humidification equipment is explained using drawing 7 , humidification equipment 100 has housing 101. The first tap hole 103 which discharges the first input 102 and desiccation air which introduce desiccation air is formed in housing 101, and the hollow fiber bundle 104 which consists of 5000 hollow fibers is contained in large numbers inside housing 101. Moreover, fixed part 105,105' which fixes the both ends of the hollow fiber bundle 104 in the state of opening is prepared in the both ends of housing 101. The second input 106 which introduces humid air is formed in the outside of a fixed part 105, and the second tap hole 107 which discharges the humid air separated and removed in moisture by the hollow fiber bundle 104 is formed in the outside of fixed part 105'. Furthermore, fixed part 105,105' is covered with the second cylinder-head cover 108 and second cylinder-head cover 109, respectively. Moreover, the second input 106 is formed in the first cylinder-head cover 108, and the second tap hole 107 is formed in the second cylinder-head cover 109.
[0004] Thus, in the humidification equipment 100 using the constituted hollow fiber, if the inside of each hollow fiber which supplies humid air from the second input 106, and constitutes the hollow fiber bundle 104 is passed, it will be separated by the capillary action of a hollow fiber, and the moisture in humid air will penetrate the inside of the capillary tube of a hollow fiber, and will move to the outside of a hollow fiber. The humid air made to separate moisture is discharged from the second tap hole 107. On the other hand, desiccation air is supplied from the first input 102. The desiccation air supplied from the first input 102 passes through the outside of the hollow fiber which constitutes the hollow fiber bundle 104. The moisture which you were made to separate from humid air is moving to the outside of a hollow fiber, and desiccation air is humidified by this moisture. And it is discharged by humidification air from the first tap hole 103.
[0005]
[Problem(s) to be Solved by the Invention] However, when the hollow fiber bundle of water permeability in a hollow fiber module froze in a cold district etc., the humidification equipment 100 using the conventional hollow fiber could not but wait for outside air temperature to rise and to thaw defrosting of a hollow fiber bundle automatically, and had produced the problem of it becoming impossible to use humidification equipment 100.
[0006] This invention is made in order to solve said technical problem, and it aims at offering the

humidification equipment equipped with a heating means by which the potential heat of the cooling water of a fuel cell can be used effective in heating of a hollow fiber for fuel cells so that the moisture in a hollow fiber may not freeze in a cold district etc.
[0007]
[Means for Solving the Problem] The humidification equipment for fuel cells indicated by claim 1 made in order to solve said technical problem The hollow fiber of water permeability of a large number allotted along with the longitudinal direction of housing is contained in said housing. In the humidification equipment for fuel cells which carries out conduction of the gas from which a moisture content differs on the inside and the outside of said hollow fiber, respectively, performs moisture exchange between said gases, and humidifies few desiccation gases of a moisture content It is characterized by using cooling water after equipping the hollow fiber bundle which bundled said hollow fiber with the heating means which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heating means.
[0008] According to invention indicated by claim 1, the hollow fiber of water permeability of a large number allotted along with the longitudinal direction of housing is contained in said housing. In the humidification equipment for fuel cells which carries out conduction of the gas from which a moisture content differs on the inside and the outside of said hollow fiber, respectively, performs moisture exchange between said gases, and humidifies few desiccation gases of a moisture content The potential heat of said cooling water can be effectively used by using cooling water after equipping the hollow fiber bundle which bundled said hollow fiber with the heating means which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heating means.
[0009]
[Embodiment of the Invention] Hereafter, the gestalt of 1 operation of the humidification equipment for fuel cells concerning this invention is explained to a detail with reference to drawing 6 from drawing 1 . In addition, drawing 1 is the whole fuel cell system block diagram with which the humidification equipment for fuel cells concerning this invention is applied. Drawing 2 is the explanatory view [-izing / the configuration of the fuel cell humidified by the humidification equipment for fuel cells concerning this invention / the explanatory view / the ** type]. The perspective view of a hollow fiber module and drawing 3 (c) of the perspective view and drawing 3 (b) which show the configuration of the humidification equipment for fuel cells which drawing 3 (a) requires for this invention are the enlarged drawings of a hollow fiber. The X-X sectional view of drawing 4 (a) and drawing 4 (c) of the sectional view and drawing 4 (b) which show the flow of the gas in the humidification equipment for the fuel cells which drawing 4 (a) requires for this invention are the Y-Y sectional views of drawing 4 (a). Moreover, the sectional view and drawing 5 (b) which show the gestalt of the first operation of the heating means which can supply a heating value to the hollow fiber bundle of water permeability contained in housing of the hollow fiber module with which the humidification equipment for fuel cells which drawing 5 (a) requires for this invention was equipped are the expansion perspective view of the heater of drawing 5 (a). The sectional view and drawing 6 (b) which show the gestalt of the second operation of the heating means which can supply a heating value to the hollow fiber of water permeability contained in housing of the hollow fiber module with which the humidification equipment for fuel cells which drawing 6 (a) requires for this invention was equipped are the enlarged drawing of the heater of drawing 6 (a).
[0010] First, with reference to drawing 1 , the whole fuel cell system configuration and operation to which the humidification equipment for the fuel cells of this invention is applied are explained. The fuel cell system FCS consists of the humidification equipment 2 a fuel cell 1 and for fuel cells, vapor-liquid-separation equipment 3, an air compressor 4, a combustor 5, the fuel evaporator 6, a reforming machine 7, a CO removal machine 8, water, methanol mixed liquor storage tank (henceforth "tank") T, etc. In addition, a fuel cell 1 is the fuel cell 1 of a solid-state macromolecule mold.
[0011] The hydeogen-rich gas as fuel gas is supplied to hydrogen pole side 1b, and a fuel cell 1 generates electricity by carrying out the chemical reaction of hydrogen and the oxygen, and taking out electrical energy from chemical energy while the humidification air as oxidant gas is supplied to oxygen pole side 1a. Humidification air is generated by compressing and humidifying the desiccation gas slack open air (air). Here, an air compressor 4 performs compression of air (dry air), and the humidification equipment 2 equipped with the heating means which can supply a heating value to the hollow fiber bundle in housing for fuel cells performs humidification. Although made by exchanging moisture between the off-gas which humidification of the dry air in the humidification equipment 2 for fuel cells is discharged from oxygen pole side of fuel cell 1 1a, and incidentally contains moisture so much, and the dry air in which only small quantity contains moisture relatively, this point is later explained to a detail. On the other hand, fuel gas

generates the mixed liquor of the water which is a original fuel, and a methanol by performing evaporation, reforming, and CO removal. Here, evaporation of a original fuel is the fuel evaporator 6, reforming is the reforming machine 7 and CO removal machine 8 performs CO removal. Incidentally the original fuel stored in Tank T is supplied to the fuel evaporator 6 through Pump P, the original fuel gas (that with which the air for reforming was mixed) which evaporated with the fuel evaporator 6 is supplied to the reforming machine 7, and the fuel gas by which reforming was carried out with the reforming vessel 7 is supplied to CO removal machine 8. In addition, with the reforming vessel 7, steam reforming and partial oxidation of a methanol are performed under existence of a catalyst. Moreover, with CO removal vessel 8, under existence of a catalyst, selective oxidation is performed and CO is converted into CO2. CO removal machine 8 consists of two, a No.1CO removal machine and a No.2CO removal machine, in order to reduce the concentration of CO as much as possible. Moreover, the air for selective oxidation is supplied to CO removal machine 8 from an air compressor 4.

[0012] In addition, although the off-gas of oxygen pole side 1a included so much generates in coincidence the water which is the off-gas and the resultant containing unused hydrogen of hydrogen pole side 1b from a fuel cell 1, after the off-gas of oxygen pole side 1a is used for humidification of air with the humidification equipment 2 for fuel cells as aforementioned, it is mixed with the off-gas of hydrogen pole side 1b, and moisture is removed by vapor-liquid-separation equipment 3. And the off-gas (mixed off-gas) with which moisture was removed burns with a combustor 5, and is used as a heat source of the fuel evaporator 6. In addition, auxiliary fuels (methanol etc.) and air are supplied, the lack of a heating value of the fuel evaporator 6 is compensated, or warming up at the time of starting of the fuel cell system FCS is performed to a combustor 5.

[0013] Next, with reference to drawing 2 , the configuration and operation of a fuel cell which make the nucleus of the fuel cell system FCS are explained. And it has expressed it as a single cel of one sheet (a fuel cell 1 is constituted in fact as a layered product which carried out the laminating of the about 200 single cels). [the fuel cell 1 in this drawing 2] [that configuration] [a ** type] As shown in drawing 2 , it is divided into hydrogen pole side 1b and oxygen pole side 1a on both sides of an electrolyte membrane 13, the electrode which included the catalyst of a platinum system in the each side is prepared, and the fuel cell 1 forms the hydrogen pole 14 and the oxygen pole 12. and the hydrogen generated from the original fuel in the hydrogen pole side gas passageway 15 -- conduction of the rich fuel gas is carried out, and conduction of the humidification air humidified with the humidification equipment 2 for fuel cells as oxidant gas is carried out to the oxygen pole side gas passageway 11. The thing using the perphloro carbon sulfonic-acid film which is a solid-state poly membrane, for example, the proton exchange film, as an electrolyte membrane 13 as an electrolyte is known. By having and carrying out the saturation water of many proton exchange groups into a solid-state macromolecule, in ordinary temperature, this electrolyte membrane 13 shows the low specific resistance below 20-ohmcm, and functions as a proton conductivity electrolyte. Therefore, under existence of a catalyst, the proton which hydrogen ionized and generated on the hydrogen pole 14 moves easily in the inside of an electrolyte membrane 13, and arrives at the oxygen pole 12. And the proton which arrived at the oxygen pole 12 reacts immediately with the oxygen ion generated from the oxygen under existence of a catalyst and in humidification air, and generates water. The generated water is discharged from the outlet of oxygen pole side 1a of a fuel cell 1 as humid gas slack off-gas with humidification air. In addition, although electronic e- generates on the hydrogen pole 14 in case hydrogen ionizes, this generated electronic e- arrives at the oxygen pole 12 via the external loads M, such as a motor. Thus, a fuel cell 1 is supplied by making humidified humidification air into oxidant gas because the proton conductivity in an electrolyte membrane 13 will become low and generating efficiency will fall, if an electrolyte membrane 13 dries. Therefore, in the fuel cell system FCS which uses the fuel cell 1 of a solid-state macromolecule mold, humidification has an important meaning. Incidentally, since the moisture content required for humidification of fuel gas is added from the beginning by the water and the methanol mixed liquor which are a original fuel, the humidification by the side of fuel gas is unnecessary, but when the moisture content required for humidification in a original fuel is not added, it can apply the humidification equipment 2 for the fuel cells of this invention.

[0014] Then, with reference to drawing 3 and drawing 4 , the configuration and operation of humidification equipment 2 for fuel cells which are the gestalt of 1 operation of this invention are explained. The humidification equipment 2 for fuel cells has the end side distributor 22 which carried out the core box, and the other end side distributor 23, and is constituted by the rectangular parallelepiped configuration as a whole while it has in juxtaposition two hollow fiber modules 21 which carried out the approximate circle pilaster, as shown in drawing 3 (a). Two hollow fiber modules 21 and 21 keep predetermined spacing

horizontally with the end side distributor 22 and the other end side distributor 23, are arranged, and are being fixed. Moreover, supply of the discharge of humidification air and off-gas with which it comes to humidify supply of dry air and discharge of off-gas through the other end side distributor 23 through the end side distributor 22 is made by each of two hollow fiber modules 21 and 21.

[0015] The hollow fiber module 21 is constituted including hollow fiber bundle 21b held in housing 21a and this housing 21a, as shown in drawing 3 (b). Housing 21a is carrying out the hollow cylinder configuration in which both ends were opened wide. Two or more (they are about eight pieces at a time to a circumferencial direction) openings are prepared in this housing 21a near [that] the both ends, respectively. On the other hand, hollow fiber bundle 21b held in housing 21a bundles thousands of hollow fibers HF which have the hollow path shown in drawing 3 (c), and securing the hollow path of a hollow fiber HF in the both-ends side (it is one end from opening) of housing 21a, it has fixed them with adhesives so that each may not be scattered. Although the part which has pasted up this hollow fiber bundle 21b on housing 21a is called potting sections 21g and 21h, the dry air (humidification air) which carries out conduction of the outside of a hollow fiber HF to the off-gas which carries out conduction of the hollow path which is the inside of a hollow fiber HF by these potting sections 21g and 21h is mixed. In addition, the end face by the side of the end of housing 21a is used as off-gas tap hole 21dout, and, as for this hollow fiber module 21, the end face by the side of the other end is used as off-gas input 21din. Moreover, opening of the circumferencial direction by the side of the end of housing 21a is used as dry air input 21cin, and opening of the circumferencial direction by the side of the other end is used as humidification airstream outlet 21cout. Incidentally, such a hollow fiber module 21 is hollow fiber HF-HF of a predetermined number to housing 21a.. After inserting in a bundle and carrying out adhesion immobilization of near the both-ends side enough with adhesives, the both ends of housing 21a are met, and it is hollow fiber HF-HF.. It is created by carrying out cutting removal of the bundle. In addition, about the detail of the heating means which can supply a heating value to the hollow fiber bundle contained in housing 21a of the hollow fiber module 21, it mentions later.

[0016] Although the end side distributor 22 fixes two hollow fiber modules 21 and 21 by position relation with the other end side distributor 23 as described above, this end side distributor 22 has off-gas outlet 22a and dry air inlet-port 22b. Off-gas tap hole 21dout of off-gas outlet 22a and each hollow fiber module 21 is connected by internal passage 22a' allotted to the interior of the end side distributor 22 (refer to drawing 4 (a) and (b)). Similarly, dry air input 21cin of dry air inlet-port 22b and each hollow fiber module 21 is connected by internal passage 22b' allotted to the interior of the end side distributor 22 (refer to drawing 4 (a) and (c)).

[0017] On the other hand, the other end side distributor 23 also has off-gas inlet-port 23a and humidification air-outlet 23b. Off-gas input 21din of off-gas inlet-port 23a and each hollow fiber module 21 is connected by internal passage 23a' allotted to the interior of the other end side distributor 23 (refer to drawing 4 (a)). Similarly, humidification airstream outlet 21cout of humidification air-outlet 23b and each hollow fiber module 21 is connected by internal passage 23b' allotted to the interior of the other end side distributor 23 (refer to drawing 4 (a)).

[0018] As the hollow fiber HF used for said hollow fiber module is shown in drawing 3 (c), a bore is the hollow filament of a 300 to about 700 micrometers thin cylindrical shape. Since the hollow fiber HF is thin, there is the description that the film pack density per hollow fiber module bears high pressure greatly. Since vapor pressure will fall in the capillary tube of a hollow fiber HF if conduction of the off-gas which is a humid gas is carried out inside a hollow fiber HF, into a capillary tube, condensation of a steam takes place and the separation principle of the moisture by this hollow fiber HF serves as the water of condensation. The capillary action of the hollow fiber HF that this water of condensation is sucked out by capillarity and penetrates to the desiccation gas side of the outside of a hollow fiber HF is used.

[0019] Next, with reference to drawing 3 and drawing 4 , an operation of the humidification equipment 2 for fuel cells is explained. Humid gas slack off-gas goes into humidification equipment 2 from off-gas inlet-port 23a of the other end side distributor 23, and reaches off-gas input 21din of the hollow fiber module 21 via internal passage 23a'. Off-gas is each hollow fiber HF-HF which branches from here and constitutes hollow fiber bundle 21b.. Conduction of the inside is carried out. Under the present circumstances, off-gas is given to the dry air which carries out conduction of the outside of a hollow fiber HF for the moisture to contain. The off-gas which carried out conduction of the inside of a hollow fiber HF escapes from a hollow fiber HF, and comes out from off-gas tap hole 21dout. each hollow fiber HF and HF -- as shown in drawing 4 (b), the off-gas which escaped from .. and came out joins, reaches off-gas outlet 22a through internal passage 22a', and faces to latter vapor-liquid-separation equipment 3. In addition, since internal passage 23a' of the other

end side distributor 23 is connected with each of the hollow fiber modules 21 and 21 which have two as aforementioned, off-gas is distributed to each hollow fiber module 21. Since it is the same as internal passage 22a' of this point and the end side distributor 22, explanation is omitted.

[0020] On the other hand, desiccation gas slack dry air goes into the humidification equipment 2 for fuel cells from dry air inlet-port 22b of the end side distributor 22, and reaches dry air input 21cin of the hollow fiber module 21 via internal passage 22b'. Dry air spreads inside [whole] housing 21a from here, and carries out conduction of the outside of a hollow fiber HF. Under the present circumstances, dry air is humidified in response to supply of moisture from off-gas, and turns into humidification air. Humidification air reaches humidification air-outlet 23b through ejection and internal passage 23b' in humidification airstream outlet 21cout to housing 21a, and goes to the latter fuel cell 1. In addition, since internal passage 22b' of the end side distributor 22 is connected with each of the hollow fiber module 21 which has two as aforementioned as shown in drawing 4 (c), dry air is distributed to each hollow fiber module 21. Since the same is said of internal passage 23b' of this point and the other end side distributor 23, explanation is omitted.

[0021] Thus, space-saving-ization can be attained by carrying out packaging of the hollow fiber module 21, securing the ease of handling.

[0022] Next, the gestalt of operation of the heating means which can supply a heating value is explained to the hollow fiber bundle of water permeability used for the humidification equipment for the fuel cells of this invention carried in the car with reference to a drawing. As the gestalt of the first operation of the heating means which can supply a heating value to the hollow fiber bundle which consists of a hollow fiber of water permeability of a large number contained in housing 21a of the hollow fiber module 21 of the humidification equipment 2 for fuel cells is shown in drawing 5 (a) It consists of three thermocouples TC for measuring the heater 37 and temperature with fin 37b which were embedded into the hollow fiber bundle 36 contained in the housing 31 of the hollow fiber module 21. It enables it to supply a heating value to the hollow fiber bundle 36 whole, looking at the temperature of Thermocouple TC.

[0023] The configuration of body of heater 37a is carrying out the shape of a rod, as shown in drawing 5 (b), and from body of heater 37a, toward the outside, fin of four sheets 37b projects it to a radial, and it is fixed to it. The configuration of fin 37b is a trapezoid, and it is fixed so that a trapezoid raised bottom may come outside. A heating value can be efficiently supplied to the hollow fiber bundle 36 whole from body of heater 37a by preparing fin 37b. Moreover, warm water supply / discharge piping 37c and 37d of two is formed in the edge of body of heater 37a. Warm water can also be used as a source of heater 37 heating by forming warm water supply / discharge piping 37c and 37d.

[0024] In this case, said body of heater 37a is a heat exchanger with a fin, and warm water is supplied by warm water supply / discharge piping 37c and 37d. With this operation gestalt, cooling water (temperature of 80 degrees C) after cooling the body of a fuel cell as warm water is used. Thus, in the humidification equipment for fuel cells, the potential heat of cooling water can be effectively used by using cooling water after equipping the hollow fiber bundle 36 which bundled the hollow fiber with the heater 37 which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heater 37.

[0025] Three thermocouples TC are suitably formed in the longitudinal direction upper part in housing 31 at spacing. Each thermocouple TC is formed so that the thermometry sensor section may serve as a position of the core of the hollow fiber module 21, in order to measure the temperature of the core of the hollow fiber module 21. In order to raise thermometry precision, four or more thermocouples TC may be formed. Thus, by forming three thermocouples TC, it can judge that the hollow fiber bundle 36 has not frozen from the value of measurement temperature in the core of the hollow fiber module 21.

[0026] Since a heating value can be supplied at a heater 37, seeing the measurement temperature of Thermocouple TC by constituting as mentioned above, it can avoid freezing the hollow fiber bundle 36 of the humidification equipment 2 for fuel cells. moreover, a certain reason -- the humidification in dry air -- supplying a heating value to the hollow fiber of water permeability, even when amount of water falls -- humidification -- the humidification stabilized in the fuel cell since amount of water was increased -- amount of water can be supplied.

[0027] Next, the gestalt of the second operation of the heating means which can supply a heating value to the hollow fiber bundle of water permeability contained in housing 21a of the hollow fiber module 21 of the humidification equipment 2 for fuel cells is explained. The exoergic means of the gestalt of the second operation enables it to supply a heating value to the hollow fiber bundle 46 whole from the outside of housing 41 at a heater 47, consisting of three thermocouples TC for measuring the temperature of the hollow fiber bundle contained in the housing 41 of the hollow fiber module 21, and a heater 47 which surrounds the

outside of housing 41, and looking at the temperature of Thermocouple TC, as shown in drawing 6 (a).
[0028] Body of heater 47a is a flexible heater, and it is wound and turned and it is prepared so that the whole outside of housing 41 may be surrounded spirally. The configuration of body of heater 47a is spiral, and warm water supply / discharge piping 47c and 47d for supplying warm water is formed in the both-sides terminal. Although drawing 6 (b) shows the heater, it is using warm water as a source of heating.
[0029] In this case, said body of heater 47a is a coil coil type heat exchanger, and warm water is supplied to a heater 47 by warm water supply / discharge piping 47c and 47d. With this operation gestalt, cooling water (temperature of 80 degrees C) after cooling the body of a fuel cell as warm water is used. Thus, in the humidification equipment 2 for fuel cells, the potential heat of cooling water can be effectively used by using cooling water after equipping the hollow fiber bundle 46 which bundled the hollow fiber with the heater 47 which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heater 47.
[0030] As shown in drawing 6 (a), three thermocouples TC are suitably formed in the longitudinal direction upper part of housing 41 at spacing. Each thermocouple TC is formed so that the thermometry sensor section may serve as a position of the core of the hollow fiber module 21, in order to measure the temperature of the core of the hollow fiber module 21. Four or more thermocouples TC may be formed. Thus, by forming Thermocouple TC, it can judge that the core of the hollow fiber module 21 has not frozen from the value of measurement temperature.
[0031] Since a heating value can be supplied at a heater 47, looking at the measurement temperature of Thermocouple TC by constituting as mentioned above, it can avoid freezing the hollow fiber bundle 36 of the humidification equipment 2 for fuel cells. moreover, a certain reason -- the humidification in dry air -- supplying a heating value to the hollow fiber of water permeability, even when amount of water falls -- humidification -- the humidification stabilized in the fuel cell since amount of water was increased -- amount of water can be supplied.
[0032] As mentioned above, modification implementation of this invention can be carried out broadly, without being limited to the gestalt of the operation which gave [above-mentioned] explanation. For example, conduction of the off-gas which is a humid gas may be carried out to the outside of a hollow fiber, and conduction of the dry air (humidification air) which is a desiccation gas may be carried out to the inside. Furthermore, with the gestalt of operation, although off-gas and dry air are passed to the counterflow, they may be passed to concurrent.
[0033]
[Effect of the Invention] According to invention given in 1. claim 1, so that clearly from the above configuration and operation The hollow fiber of water permeability of a large number allotted along with the longitudinal direction of housing is contained in said housing. In the humidification equipment for fuel cells which carries out conduction of the gas from which a moisture content differs on the inside and the outside of said hollow fiber, respectively, performs moisture exchange between said gases, and humidifies few desiccation gases of a moisture content Freezing of the moisture in a hollow fiber can be prevented by using cooling water after equipping the hollow fiber bundle which bundled said hollow fiber with the heating means which can supply a heating value and cooling the body of a fuel cell as a source of heating of this heating means, using the potential heat of said cooling water effectively.

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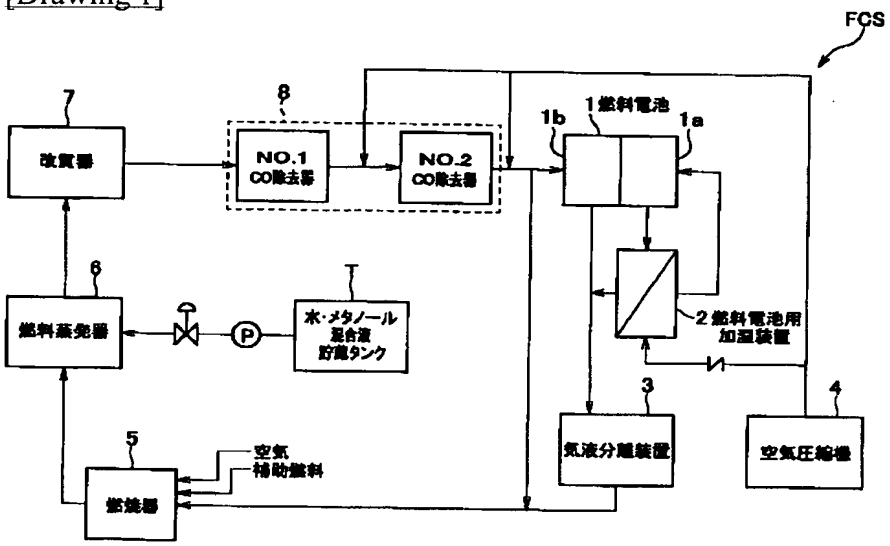
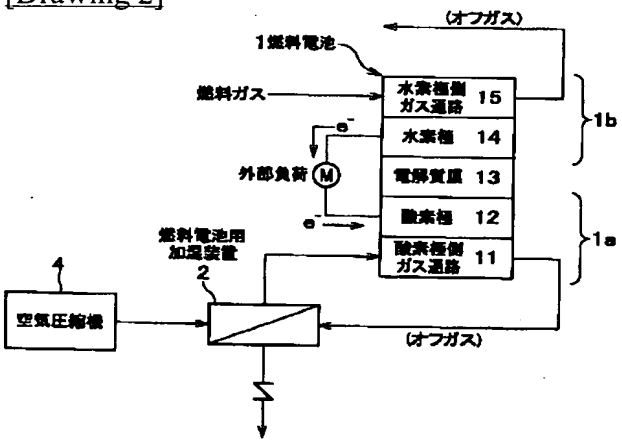
DRAWINGS

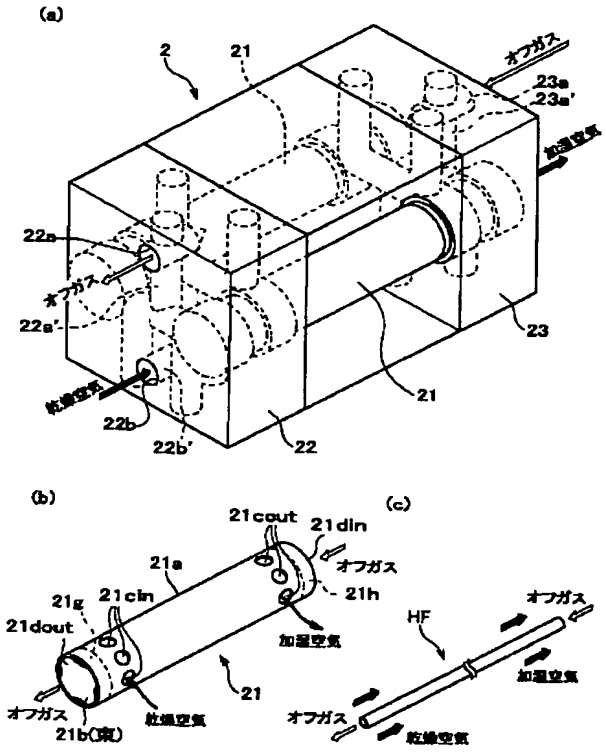
[Drawing 1]



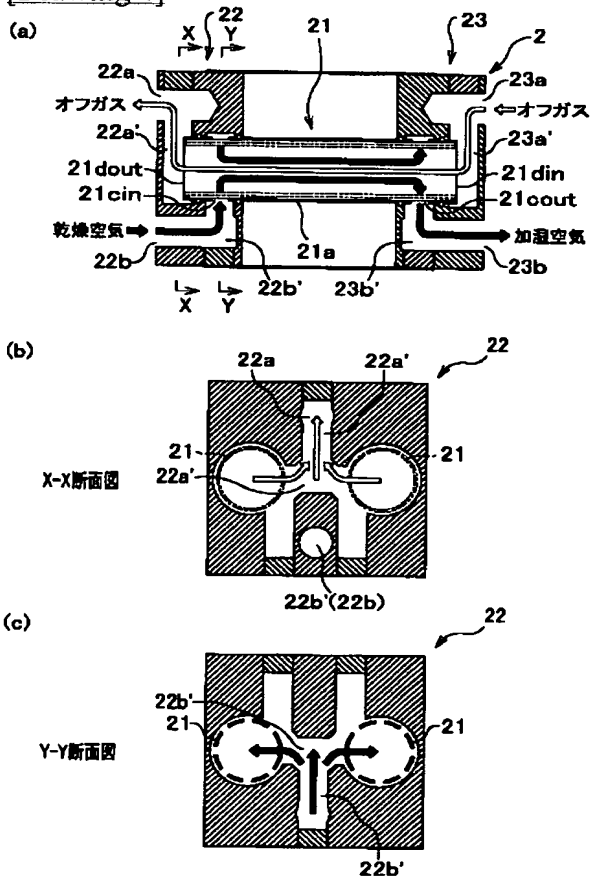
[Drawing 2]



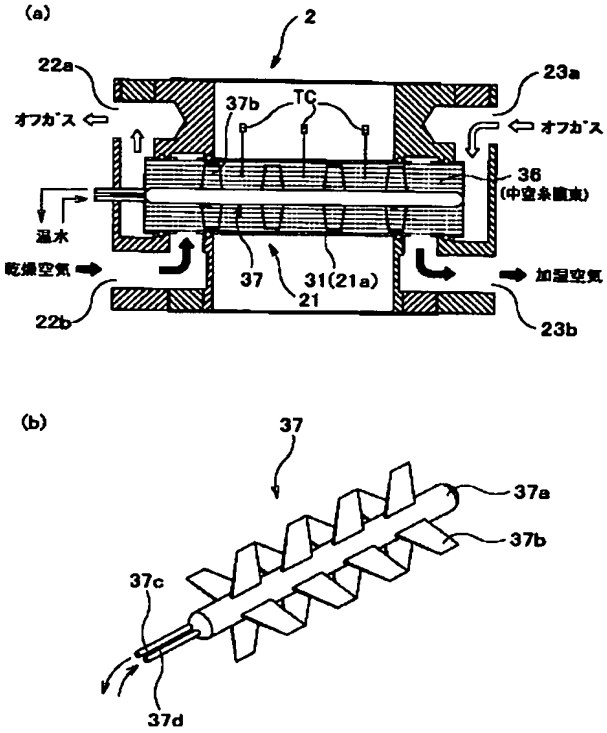
[Drawing 3]



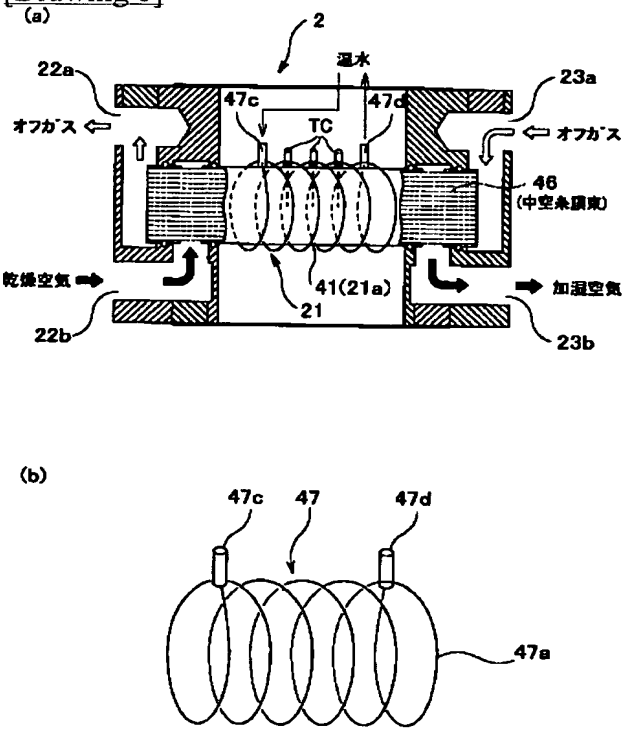
[Drawing 4]



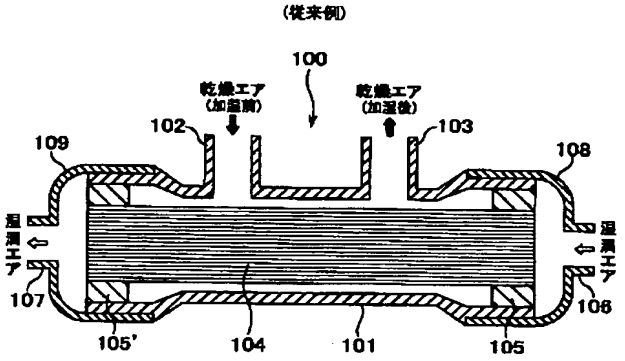
[Drawing 5]



[Drawing 6]



[Drawing 7]



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